REMARKS

Claim 1-8 and 10-18 are pending in the above-identified application. Support for the changes to Claim 1 is found on page 23, lines 15-27 of the present specification. In this regard, note that the spectrophotometer described on page 23 produces unpolarized light.

It is respectfully requested that the above claim changes be entered and fully considered by the Examiner. These changes at least place the claims into better form for consideration on appeal pursuant to 37 CFR 1.116(b).

Issues under 35 USC 102(b) and 103(a)

Claims 1-5, 7-12 and 16-20 have been rejected under 35 USC 102(b) as being anticipated by Weber '230 (US 6,531,230), with Arends '659 (US 5,360,659) as evidentiary support.

Claims 6 and 13-15 have been rejected under 35 USC 103(a) as being unpatentable over Weber '230, with Arends '659 as evidentiary support.

These rejections are traversed based on the following reasons.

Distinctions over Cited References

Both Weber '230 and Arends '659 fail to disclose or suggest a laminated film having a maximum light ray reflectivity for unpolarized light, such a natural light, of 25% or less in the wavelength range of 400 to 2,500 nm, as in the presently claimed invention. Applicant submits that because the films of Weber '230 disclosed in Figures 23 to 25 are uniaxially oriented films, significant differences in optical characteristics exist between these films of Weber '230 and the film of the present invention. A detailed explanation of these films of Weber '230 follows.

Weber '230 provides an explanation regarding Figures 23 to 25 at col. 63, lines 20-58. Weber '230 discloses that, "FIGS. 23, 24 and 25 show the transmission spectra for the films of EXAMPLES E2-1, E2-2, and E2-3, respectively, for the cases of the E-field of incident light parallel to the stretch direction and parallel to the non-stretch direction at 0 and 60 degrees to these films."(col. 63, lines 43-46 of Weber). In this regard, it is submitted that a person skilled

in the art would understand that there are four line plots corresponding to 4 measurement conditions in each figure, namely:

	Direction of E-field of Incident Light	Incident Angle
(i)	parallel to the stretched direction	0 degrees
(ii)	parallel to the non-stretched direction	0 degrees
(iii)	parallel to the stretched direction	60 degrees
(iv)	parallel to the non-stretched direction	60 degrees

In this regard, it is noted that the "E-field" (or "electric field") direction and the direction of polarized light are considered synonymous in the field of optics. Weber '230 further discloses that, "Note the reflectance band shift of about 90 nm from 0 degrees to 60 degrees of incidence with the E-field parallel to the stretch direction,..." (see col. 63, lines 47-49, emphasis added). One skilled in the art would understand that when the direction of polarized light is parallel to the stretched direction then light reflectance occurs within certain wavelength range and this reflectance band shifts with an increasing incidence angle, such that one can easily conclude that line plot "F" in Fig. 23 corresponds to the condition (i) above, and line plot "E" in Fig. 23 corresponds to the condition (iii) above. Weber '230 further discloses that, "...the lack of a peak when the E-field is parallel to the non-stretch direction for the cyan to blue polarizer," (see col. 63, lines 50-51, emphasis added). One skilled in the art would understand from this that when the direction of polarized light is parallel to the non-stretched direction, then the transmittance of light in a wavelength range corresponding to the peak becomes almost equal to the transmittance of light in a wavelength range outside that corresponding to the peak. Taking into account the relationship between transmittance and incidence angle theories in the field of optics, one skilled in the art can easily determine that the line plot "G" in Fig. 23 corresponds to the condition (ii) above and the line plot "H" in Fig. 23 corresponds to the condition (iv) above.

In addition to the above, it is noted that, as an electromagnetic wave, light has been described in the field of optics as including two mutually perpendicular wave components, i.e. the "p-wave" and the "s-wave". In natural, unpolarized light, the amplitude of the p-wave and s-wave are approximately equivalent, whereas in contrast, in polarized light the amplitude of either the p-wave or the s-wave is zero. Optics theory further provides that the percentage of

reflectance of light ($R(\Theta)$) at a certain incident angle can be calculated with the following equation (1):

$$R(\Theta) = 1/2[Rp(\Theta) + Rs(\Theta)] \quad (1)$$

wherein, Θ is the incident angle, Rp is the reflectance of the p-wave and Rs is the reflectance of the s-wave. Equation (1) is used to calculate the "reflection coefficient" in accordance with the well known "Fresnel equations" as explained at the top of page 2 of enclosed Exhibit A (pages 1-3 from Wikipedia at www.wikipedia.org). Taking this into account, it is noted that Weber '230 discloses the use of unpolarized light in Fig. 23 wherein the wave component of the light in a plane parallel to the stretched direction is strongly reflected (i.e. the reflectance of the light is almost 100%) within a wavelength range of 620-780nm and at an incident angle of zero degrees; but the light having a wavelength range outside 620-780nm exhibited high transmission (i.e. low reflectance). Fig. 23 further shows that the wave component of the light in a plane parallel to the non-stretched direction exhibited high transmission (i.e. a reflectance of about 10%) in a wavelength range of 400-1200 nm with an incident angle of zero degrees. Accordingly, the reflectance in the wavelength range of 620-780nm in Fig. 23 of Weber '230 can be calculated to be approximately 55% ((100 + 10)/2) based on the equation above and assuming an incident angle of zero degrees. Also, the reflectance in the wavelength range of outside 620-780nm in Fig. 23 can be calculated to be approximately 10% ((10 + 10)/2) based on the equation above and assuming an incident angle of zero degrees. Consequently, the maximum light ray reflectivity of the film disclosed in Fig. 23 of Weber '230 for unpolarized light in the wavelength range of 400-2500nm is at least approximately 55%. In addition, at an incident angle of 60 degrees, the maximum light ray reflectivity of the film disclosed in Fig. 23 of Weber '230 for unpolarized light in the wavelength range of 620-780nm is calculated to be approximately 70% ((100 + 40)/2).

The maximum light ray reflectivity values for the films disclosed in Fig. 24 and Fig. 25 can also be calculated in a manner similar to that set forth above with respect to Fig. 23. Therefore, the none of the above-noted film examples of Weber '230 exhibit the light ray reflectivity properties of the film of the present invention of 25% or less.

Further, Weber '230 fails to suggest to one skilled in the art how to modify the films described therein to arrive at the film of the present invention. Arends '659 fails to make up for these deficiencies in Weber '230. Thus, significant patentable distinctions exist between the present invention and both Weber '230 and Arends '659 such that the above rejection must be withdrawn.

It is submitted for the reasons above that the present claims define patentable subject matter such that this application should now be placed in condition for allowance.

If any questions arise in the above matters, please contact Applicant's representative, Andrew D. Meikle (Reg. No. 32,868), in the Washington Metropolitan Area at the phone number listed below.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

Dated: April 3, 2009

Respectfully submitted,

By______________________________

Andrew D. Meikle
Registration No.: 32,868
BIRCH, STEWART, KOLASCH & BIRCH, LLP
8110 Gatehouse Road
Suite 100 East
P.O. Box 747
Falls Church, Virginia 22040-0747
(703) 205-8000
Attorney for Applicant

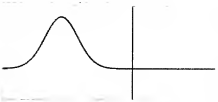
Enclosure: Exhibit A

Exhibit A
USSN 10/575,777
Atty Docket No.
0599-0215PUS1

Fresnel equations

From Wikipedia, the free encyclopedia

The **Fresnel equations**, deduced by Augustin-Jean Fresnel (pronounced /freɪˈnɛl/), describe the behaviour of light when moving between media of differing refractive indices. The reflection of light that the equations predict is known as **Fresnel reflection**.



Partial transmission and reflection amplitudes of a wave travelling from a low to high refractive index medium.

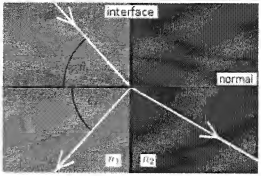
Contents

- 1 Explanation
- 2 Effect from multiple surfaces
- 3 See also
- 4 References
- 5 External links

Explanation

When light moves from a medium of a given refractive index n_1 into a second medium with refractive index n_2, both reflection and refraction of the light may occur.

In the diagram on the right, an incident light ray **PO** strikes at point **O** the interface between two media of refractive indexes n_1 and n_2. Part of the ray is reflected as ray **OQ** and part refracted as ray **OS**. The angles that the incident, reflected and refracted rays make to the normal of the interface are given as θ_i, θ_r and θ_t, respectively. The relationship between these angles is given by the law of reflection and Snell's law.



Variables used in the Fresnel equations.

The fraction of the incident power that is reflected from the interface is given by the *reflection coefficient R*, and the fraction that is refracted is given by the *transmission coefficient T*.[1] The media are assumed to be *non-magnetic*.

The calculations of R and T depend on polarisation of the incident ray. If the light is polarised with the electric field of the light perpendicular to the plane of the diagram above (s-polarised), the reflection coefficient is given by:

$$R_s = \left[\frac{\sin(\theta_t - \theta_i)}{\sin(\theta_t + \theta_i)}\right]^2 = \left[\frac{n_1\cos(\theta_i) - n_2\cos(\theta_t)}{n_1\cos(\theta_i) + n_2\cos(\theta_t)}\right]^2 = \left[\frac{n_1\cos(\theta_i) - n_2\sqrt{1 - \left(\frac{n_1}{n_2}\sin\theta_i\right)^2}}{n_1\cos(\theta_i) + n_2\sqrt{1 - \left(\frac{n_1}{n_2}\sin\theta_i\right)^2}}\right]^2$$

where θ_t can be derived from θ_i by Snell's law and is simplified using trigonometric identities.

If the incident light is polarised in the plane of the diagram (p-polarised), the R is given by:

$$R_p = \left[\frac{\tan(\theta_t - \theta_i)}{\tan(\theta_t + \theta_i)}\right]^2 = \left[\frac{n_1\cos(\theta_t) - n_2\cos(\theta_i)}{n_1\cos(\theta_t) + n_2\cos(\theta_i)}\right]^2 = \left[\frac{n_1\sqrt{1 - \left(\frac{n_1}{n_2}\sin\theta_i\right)^2} - n_2\cos(\theta_i)}{n_1\sqrt{1 - \left(\frac{n_1}{n_2}\sin\theta_i\right)^2} + n_2\cos(\theta_i)}\right]^2$$

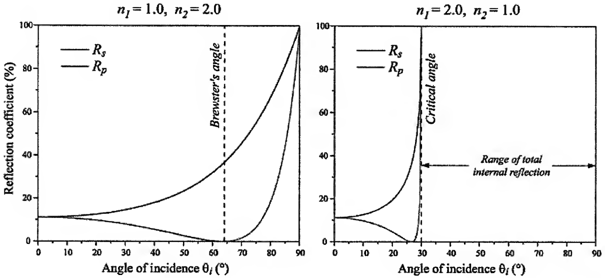
The transmission coefficient in each case is given by $T_s = 1 - R_s$ and $T_p = 1 - R_p$.[2]

If the incident light is unpolarised (containing an equal mix of *s*- and *p*-polarisations), the reflection coefficient is $R = (R_s + R_p)/2$.

Equations for coefficients corresponding to ratios of the electric field amplitudes of the waves can also be derived, and these are also called "Fresnel equations".

At one particular angle for a given n_1 and n_2, the value of R_p goes to zero and a *p*-polarised incident ray is purely refracted. This angle is known as Brewster's angle, and is around 56° for a glass medium in air or vacuum. Note that this statement is only true when the refractive indexes of both materials are real numbers, as is the case for materials like air and glass. For materials that absorb light, like metals and semiconductors, *n* is complex, and R_p does not generally go to zero.

When moving from a denser medium into a less dense one (i.e., $n_1 > n_2$), above an incidence angle known as the *critical angle*, all light is reflected and $R_s = R_p = 1$. This phenomenon is known as total internal reflection. The critical angle is approximately 41° for glass in air.



When the light is at near-normal incidence to the interface ($\theta_i \approx \theta_t \approx 0$), the reflection and transmission coefficient are given by:

$$R = R_s = R_p = \left(\frac{n_1 - n_2}{n_1 + n_2}\right)^2$$
$$T = T_s = T_p = 1 - R = \frac{4 n_1 n_2}{(n_1 + n_2)^2}$$

For common glass, the reflection coefficient is about 4%. Note that reflection by a window is from the front side as well as the back side, and that some of the light bounces back and forth a number of times between the two sides. The combined reflection coefficient for this case is $2R/(1 + R)$, when interference can be neglected. (See below.)

It should be noted that the discussion given here assumes that the permeability μ is equal to the vacuum permeability μ_0 in both media. This is approximately true for most dielectric materials, but not for some other types of material. The completely general Fresnel equations are more complicated.

Effect from multiple surfaces

For more details on this topic, see Transfer-matrix method (optics).

When light makes multiple reflections between two or more parallel surfaces, the multiple beams of light generally

interfere with one another, resulting in net transmission and reflection amplitudes that depend on light-wavelength in a complicated way. An example of this effect is the colours seen in oil films on water. Other applications include Fabry-Perot interferometers, optical coatings that can greatly lower the reflectivity of a surface, and optical filters. A quantitative analysis of these effects is based on the Fresnel equations, but with additional calculations to account for interference. The transfer-matrix method can be used to solve these problems.

See also

- Index-matching material
- Fresnel rhomb, Fresnel's apparatus to produce circularly polarized light [1]
- Specular reflection
- Schlick's approximation

References

1. ^ Hecht (1987), p. 100.
2. ^ Hecht (1987), p. 102.

- Hecht, Eugene (1987). *Optics* (2nd ed. ed.). Addison Wesley. ISBN 0-201-11609-X.

External links

- Fresnel Equations – Wolfram
- FreeSnell – Free software computes the optical properties of multilayer materials
- Thinfilm – Web interface for calculating optical properties of thin films and multilayer materials. (Reflection & transmission coefficients, ellipsometric parameters Psi & Delta)
- Simple web interface for calculating single-interface reflection and refraction angles and strengths.
- ReflectionCoefficient.INFO – Optical reflection coefficient calculator
- Reflection and transmittance for two dielectrics - Mathematica interactive webpage that shows the relations between index of refraction and reflection.